EFFECT OF SOME MACRO AND MICRONUTRIENTS ON GROWTH, YIELD AND CHEMICAL CONSTITUENTS OF CHAMOMILE PLANTS (*Matricaria chamomill*a L.) GROWN UNDER NEWLY RECLAIMED SOIL CONDITIONS.

Faisal M. A. Matter
Horticulture Dept., Faculty of Agriculture, Fayoum University.

ABSTRACT

The present study was carried out in field during the growing seasons 2004/2005 and 2005/2006 to investigate the effect of macronutrients at the rates of N (75 and 100 kg /fed). P_2O_5 (32 and 50 kg./fed.) and K_2O (24 and 36 kg./fed.) and the mixture of micronutrients (Fe, Mn and Zn at the rate of 2%) on growth, yield and chemical constituents of chamomile plants. The data obtained from the study show that the treated plants with the high rates of macronutrients (NPK) either alone or in combination with each others increased all the studied characters such as growth parameters (plant height, number of branches, fresh and dry weights of plant), yield (number of inflorescences/plant, fresh and dry weights of inflorescences/plant and dry yield /fed.) and some chemical constituents such as (N, P, K, Fe, Mn, Zn, pigments and total carbohydrates). Also yield of oil (oil percentage, oil yield/ plant and fedann) Generally, the maximum increase of the previous characters was obtained by the treatment which contain the high rate of NPK fertilizers (100, 50 and 36 kg/fed., respectively) either alone or in combination with spraying chamomile plants with micronutrients (Fe, Zn and Mn) at the concentration of 2%.

Therefore, under newly reclaimed soil conditions prefer fertilization chamomile plants with (100, 50 and 36 kg/fed. from NPK fertilizers, respectively in combination with micronutrients (Fe, Zn and Mn) at the concentration 2% to obtain the good yield from the plants.

Key words: Chamomile plants, macro and micronutrients, growth, yield, chemical constituents.

INTRODUCTION

Nowdays, more tendency for cultivation of aromatic plants has been shown in Egypt in order to cover the increasing demands of the local industries and it is a good source of hard currency.

In Egypt the chamomile (*Matricaria chamomill*a L.) Family Asteraceae is found in its wild state **(Tackholm, 1974)** and was well to ancient Egyptians as an aromatic plant and it has many medicinal uses. Mild infusion of the chamomile flowers is used as a remedy against fever, in digestion, intestinal pain, as a mild tonic and antispasmodic. The flowers are applied externally against inflammation or irritation. The oil is also used as a flavoring agent in fine liqueurs and is also used in cosmetics. Chamozulene is responsible the blue color of the oil.

The increasing demand on chamomile for the pharmaceutical industries encouraged the investigators to perform studies leading to increase the quantity and improve the quality of the extracted active ingredients.

Under newly reclaimed soils, there is an evidence for a general decline in macro and micronutrients that can affect plant growth and yield. Using such nutrients in the fertilization of these plants, i.e. they are able to unit

simultaneously with enzymes or substrates upon which enzymes depend and consequently limit growth and yield of several crops.

Mohamed (1989) mentioned that the treated chamomile plant with different levels of macro (NPK) and miconutrients (Fe, Zn and Mn) caused positive effect on vegetative growth (plant height, number of branches and fresh and dry weights of herb) and on yield (number of inflorescences/plant, fresh and dry weights of inflorescences/plant as well as oil percentage). **Medani (1998)** on damsisa, found that plant height, number of branches plant^{-1}, number of inflorescences, dry weight of plant, N, P, K and total carbohydrates % were significantly increased by NPK fertilizations. **Naguib and Aziz (2003)** on *Hyoscyamus muticus,*showed that all treatments (NPK) increased the plant growth measurements, total carbohydrates, soluble sugars, nitrogen, phosphorus, potassium and total alkaloids. **Swaefy Hend *et al.* (2007)** on *Mentha piperita* found that the treatment of 175 kg fed^{-1}ammonium sulphate and 100 kg fed^{-1}calcium superphosphate (50% NP) gave the highest total oil per plant and per feddan, **Attoa (2008)** on gladiolus, noticed that treatments of mineral NPK were significantly, equal in producing the best vegetative growth, flowering parameters and chemical constituents, **Farag (2006)** on cotton and tomato plants, found that the deficiency of N, P, K, Fe, Mn and Zn in soil solution significantly decreased the growth, yield and chemical constituents of plants and Also, **El-Sharkawy *et al*., (2008)** demonstrated that spraying plants with microelements (Fe, Zn and Mn) appeared to be the most effective treatment in increasing the growth rate and yield of Jerusalem artichoke plants, **Hassanain *et al.*(2006**) found that spraying chamomile plants with Fe, Zn and Mn either alone or in combination increased growth parameters (number of branches, plant height and fresh and dry weights of herb), yield (number of inflorescences, fresh and dry weights of inflorescences/plant) also, increased chemical concentrations such as chlorophyll a, b and carotenoids, N, P, K, Fe, Mn, Zn, total carbohydrates and oil percentage and **Matter and El-Yazal (2002)** on damsisa, noticed that all treatments (Fe, Zn and Mn) significantly increased plant height, number of branches and fresh and dry weights of herb. Also, increased chlorophyll a, b and carotenoids, carbohydrates content N, P, K, Fe, Mn and Zn percentage.

The aim of this work was to study the effect of different rates of N, P, K and some micronutrients on morphological character, yield and some chemical constituents of chamomile plants under newly reclaimed soil.

MATERIALS AND METHODS

Two field experiments were performed in private farm at Tamya, Fayoum Governorate, Egypt. during two successive seasons of 2004/2005 and 2005/2006 in the Sandy loam soil to study the effect of some macro and microfertilization treatments on growth, yield and chemical constituents of chamomile plants grown under newly reclaimed soil conditions. The physical and chemical analysis of soil in the experimental site are conducted according the standard methods described by **Klute (1986)** and **Page *et al.*(1982)** in Table (1).

Table (1): Physical and chemical properties of the soil used in the experiment.

Years	Mechanical analysis								
	Sand %		Silt %		Clay %		Texture class		
2004	78.50		15.70		5.80		Sandy loam		
2005	78.31		16.88		4.81		Sandy loam		
Years	**Available nutrients (mg./kg.)**								
	Soil pH	EC	N	P	K	Fe	Mn	Zn	$CaCo_3$%
2004	7.7	2.73	18.5	11.4	276	2.3	0.82	0.31	11.30
2005	7.7	2.31	19.6	10.3	269	2.1	10.91	0.30	10.8

Chamomile seedlings were obtained from administrative of Apshway, Fayoum Governorate, Egypt. The uniform seedlings are 35 days old were transplanted on 25th of October in the two seasons. The normal cultural practices for growing chamomile plant prevailing in the locality were followed.

Treatments:

Macronutrients were added as soil application at two rates of N (N_1= 75 and N_2 = 100 kg /fed. of ammonium nitrate (33.5%N); P_2O_5 (P_1= 32 and P_2 = 50 kg./fed.) as calcium superphosphate 15.5% P_2O_5 and K_2O (K_1 =24 and K_2 = 36 kg./fed.) as potassium sulphate 48% K_2O. The NPK fertilizers were divided into to equal doses and were added at 30 and 60 days after transplanting.

Micronutrients: The respective source of Fe, Mn and Zn was the commercial fertilizer namely Prosol containing Fe, Mn and Zn at 20, 20 and 25%, respectively. The mixture of micronutrients were added as foliar application at the concentration of 2% and few drops of Triton B were added to the spray solution to serve as a wetting agent. The micronutrients were sprayed twice coincided with the soil application of the tested macronutrients (NPK). Control plants ($N_1P_1K_1$) received the recommended fertilizer of the Agricultural Ministry, Egypt. (75 N, 32 P_2O_5 and 24 K_2O kg/fed.).

The fertilization treatments used were:

T_0	T_1
1- $N_1P_1K_1$.	9- $N_1P_1K_1$ + micronutrients.
2- $N_2P_1K_1$.	10- $N_2P_1K_1$ + micronutrients.
3- $N_1P_2K_1$.	11- $N_1P_2K_1$ + micronutrients.
4- $N_1P_1K_2$.	12 - $N_1P_1K_2$ + micronutrients.
5- $N_2P_2K_1$.	13- $N_2P_2K_1$ + micronutrients.
6- $N_2P_1K_2$.	14- $N_2P_1K_2$ + micronutrients.
7- $N_1P_2K_2$.	15- $N_1P_2K_2$ + micronutrients.
8- $N_2P_2K_2$.	16 $N_2P_2K_2$ + micronutrients.

The experimental design was a randomized complete blocks with 3 replications. Each experimental unit consisted of 7 rows 3 m. long and 50 cm width, the spacing between seedlings were 30cm.

Data recorded:

1- Morphological characters:

The samples of plants were taken randomly from each plot (12 plants) at the age of 120 days (full blooming) to record : Plant height (cm.), number of branches, fresh and dry weights of herb (g).

2- Yield and its components:

Twelve plants from each plot at the beginning of flowering till the final season were randomly chosen to study, number of capetulum plant^{-1}, fresh and dry weight of capetulum (g.) and yield of dry capetulum /fed. The picking of

inflorescences were achieve every 7 days, when the ligulate flowers were horizontally on the tours (**Franz, 1980**) and dried in the shade for two weeks until constant weight, then yield of inflorescences plant^{-1} were recorded (fresh weight of capetulum was taken during picking)

3- Chemical constituents:

Chlorophylls (a & b) and carotenoids concentrations (mg g^{-1} fresh weight of leaf) were determined using colorimetric method as described by **Welburn and Lichtenthaler (1984).** Total carbohydrates (%) were colorimetrically determined according to the method described by **Herbert *et al.* (1971).** Nitrogen % was colorimetrically determined by using the Orange G dye according to the method of **Hafez and Mikkelsen (1981)**. For P, K, Fe, Mn and Zn determination, the wet digestion of 0.1g. of fine dry material of herb of each treatment was done by using sulphuric and perchloric acids as described by **Piper (1947).** Phosphorus and potassium % were determined after wet digestion of plant material according to **Page *et al.* (1982)**. Iron, manganese and zinc concentrations (ppm.) were determined according to the method of described by **Chapman and Pratt. (1961).** Essential oil percentage, A random of dry inflorescences from each treatment was selected and subjected to hydro distillation according to the **Egyptian Pharmacopoeia (1984).** Oil yield / plant and per feddan were calculated.

There results were statistically analysis using the LSD at probability level of 5% for comparison **(Gomez and Gomez, 1983).**

RESULTS AND DISCUSSION

1-<u>Morphological characters</u>:

Data presented in Table (2) clearly show that increasing the rates of N, P or K fertilization from (75 to 100 kg N./fed.), (32 to 50 kg. P_2O_5/fed.) and (24 to 36kg. K_2O/fed.) either alone or in combination with each other significantly increased the plant height, number of branches, fresh and dry weights of chamomile plants which grown under newly reclaimed soil conditions as compared to the control plants. Generally, the combination between the high rates of N (100kg./fed.), P (50kg./fed.) and K (36 kg./fed. fertilizers) $N_2P_2K_2$ gave the best results of the morphological parameters, which reach, 23.39, 41.67, 50.36 and 28.87 % for plant height, number of branches, fresh and dry weights, respectively in the first season, as compared to the control plants. Similar trend was observed in the second season. The results are in harmony with those obtained by **Medani (1998)** on damsisa and **Naguib and Aziz (2003)** on *Hyoscyamum muticus* L.; **Farag (2006)** on cotton and tomato plants; **Swaefy Hend *et al*. (2007)** on *Mentha piperita* and **Attoa (2008)** on gladiolus. The addition of micronutrients to different treatments of NPK significantly increased the above parameters, especially the $N_2P_2K_2$ treatment gave the highest rate of increase reach, 34.06, 79.17, 64.11 and 35.90%, respectively in the first season, as compared to the untreated plants. The same results were obtained in the second season. These results are in agreement with those obtained by **Mohamed (1989)** on chamomile plant; **Jacoub (1995)** on *Ocimum basilicum*; **Mohamed *et al.*, (2001)** on roselle plants; **Abed and Agamy (2002)** on spearmint and **Matter and El-Yazal (2002)** on damsisa and **Farag (2006)** on cotton and tomato plants.

Regarding the positive effect of mineral fertilizers on growth characters of chamomile plants, this may be attributed to the role of nitrogen in protoplasm formation and all proteins e.g. amino acids, nucleic acid, many enzymes and

energy transfer materials ADP and ATP (**Russel,1989**). Also, the role of phosphorus as a major nutrient element, where phosphorus compounds are of absolute necessity for all living organism, nucleo proteins constituting the essential substances of the cell and for division and development of meristematic tissues (**Yagodin, 1982)**. Potassium is important for plant growth and is involved in every metabolic process, including carbohydrates metabolism, protein biosynthesis, assimilate translocation, conformation of enzymes and stomatal movement (**Munson, 1972**). These effects were reflected on vigorous vegetative growth such as plant height, number of branches and consequently fresh and dry weights of plant.

The effect of spraying with micronutrients on growth parameters might be mainly due to that the role of micronutrients in the physiological and metabolic in the plants during different stages of growth such as iron is a vital catalyst in the plant and formation of chlorophylls. The effect of Zn may be due to its direct influence in the synthesis of tryptophan, and consequently the formation of auxin IAA and its important function in plant metabolism. Mn, also is necessary for the formation of chlorophyll and involved in several enzymes which attributed to carbohydrates and protein metabolism. These important function for micronutrients was reflected on the vegetative growth, i.e. plant height , number of branches, fresh and dry weights of herb.

Table (2): Effect of macro and micronutrients on morphological parameters of chamomile plants grown under newly reclaimed soil conditions.

Treatments	plant height (cm.)		No. of branches plant $^{-1}$		Fresh Weight plant $^{-1}$ (g.)		Dry Weight plant $^{-1}$ (g.)	
	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1
First season 2004/2005								
Control	34.20	38.20	12.00	16.50	81.50	90.00	48.50	51.20
$N_2P_1K_1$	39.15	42.00	14.00	18.00	93.55	113.50	53.12	59.61
$N_1P_2K_1$	40.20	41.40	14.00	17.00	85.20	113.00	50.00	57.52
$N_1P_1K_2$	38.90	43.88	13.50	16.50	92.13	98.20	52.50	55.29
$N_2P_2K_1$	41.50	43.40	15.67	18.00	97.40	114.00	56.20	58.20
$N_2P_1K_2$	40.58	45.33	15.67	18.00	100.00	118.90	56.31	59.75
$N_1P_2K_2$	37.00	43.20	16.33	20.10	99.75	118.50	56.10	60.00
$N_2P_2K_2$	42.20	45.85	17.00	21.50	122.54	133,75	62.50	65.91
Mean	39.22	42.91	14.77	18.20	96.51	112.48	54.40	58.44
LSD 5%	**3.02**		**1.05**		**8.58**		**4.16**	
Second season 2005 / 2006								
Control	35.30	39.00	13.00	17.00	84.50	92.80	48.90	51.88
$N_2P_1K_1$	40.33	42.66	15.67	18.00	95.78	115.00	54.22	59.99
$N_1P_2K_1$	41.00	41.33	14.00	18.00	85.50	114.50	50.85	57.00
$N_1P_1K_2$	40.67	44.50	14.67	17.67	94.40	98.70	51.90	55.95
$N_2P_2K_1$	42.67	44.67	16.33	18.67	99.50	115.00	56.94	57.55
$N_2P_1K_2$	41.67	45.67	15.67	19.00	100.00	120.00	57.03	60.00
$N_1P_2K_2$	38.50	44.50	16.33	19.67	100.00	118.00	56.75	61.03
$N_2P_2K_2$	42.33	46.33	18.67	21.33	125.11	135.60	63.50	66.81
Mean	40.43	43.58	15.54	18.67	98.10	113.70	55.01	58.78
LSD 5%	**3.11**		**1.12**		**9.03**		**4.55**	

T_0 and T_1= The treatments without and with micronutrients, respectively.

2- Yield and its components:

With regards to the values of the yield and its components of chamomile plants (number of inflorescences/plant, fresh and dry weights of inflorescences/ plant and dry yield/fed.) as affected by the different fertilizers treatments. Data in Table (3) generally show that fertilizing with the high rate of N, P and K alone or together increased the above characters. The maximum increase of these parameters was obtained by the $N_2P_2K_2$ treatment which found to be, 12.03, 23.75, 20.37 and 19.53 %, respectively, in the first season, as comparing with control plants.

These results are in the same line with those observed by **Medani (1998)** on damsisa and **Naguib and Aziz (2003)** on *Hyoscyamus muticus*, L.; **Farag (2006)** on cotton and tomato plants; **Swaefy Hend *et al*. (2007)** on *Mentha piperita* and **Attoa (2008)** on gladiolus.

It is clear that spraying with micronutrients combined with the high rates of N, P or K either alone or together increased significantly the yield and its components as compared with the untreated plants ($N_1P_1K_1$**)**. The greatest increase was recorded by the treatment (100 kg N, 50 kg P and 36 kg/fed. K + mixture of micronutrients) which being, 15.72, 37.50, 32.38 and 29.30% respectively, in the first season, as compared the control plants. Similar result was obtained in the second season.

Table (3): Effect of macro and micronutrients on yield and its components of chamomile plants grown under newly reclaimed soil conditions.

Treatments	Number of capetulum Plant $^{-1}$		Fresh Weight of capetulum Plant $^{-1}$ (g.)		Dry Weight of capetulum Plant $^{-1}$ (g.)		Dry Weight of capetulum Fed^{-1}. (kg.)	
	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1
First season 2004/2005								
Control	855.50	890.50	80.00	89.00	19.15	21.11	774.00	842.00
$N_2P_1K_1$	870.40	895.00	85.00	90.30	19.26	21.90	782.40	874.00
$N_1P_2K_1$	872.30	894.00	82.50	89.20	19.50	21.45	780.00	872.00
$N_1P_1K_2$	870.50	890.00	84.00	88.00	19.44	21.30	782.00	860.00
$N_2P_2K_1$	885.40	918.10	85.90	92.50	19.85	22.00	834.40	884.00
$N_2P_1K_2$	890.60	948.00	89.10	97.10	21.08	22.30	852.00	900.00
$N_1P_2K_2$	890.00	945.70	90.00	97.65	22.00	23.10	900.00	920.00
$N_2P_2K_2$	958.40	990.00	99.00	110.00	23.05	25.35	925.20	1000.80
Mean	886.64	921.41	86.94	94.22	20.42	22.30	828.75	894.10
LSD 5%	**26.07**		**3.08**		**1.10**		**52.50**	
Second season 2005 / 2006								
Control	860.80	895.50	82.18	89.50	19.35	21.05	775.20	842.95
$N_2P_1K_1$	879.33	900.00	85.31	91.20	19.56	21.85	783.40	874.99
$N_1P_2K_1$	875.10	896.10	83.11	90.10	19.50	21.80	782.00	872.00
$N_1P_1K_2$	877.20	899.50	84.25	90.92	19.56	21.60	782.00	861.33
$N_2P_2K_1$	890.20	920.50	88.92	94.50	20.91	22.10	836.50	885.96
$N_2P_1K_2$	898.30	951.00	90.12	98.20	21.31	22.95	853.22	902.15
$N_1P_2K_2$	899.00	950.00	91.00	99.30	22.50	23.05	901.00	922.50
$N_2P_2K_2$	969.50	994.40	99.35	109.70	23.18	25.32	927.55	1000.00
Mean	893.68	925.88	88.03	95.43	20.73	22.47	830.06	895.24
LSD 5%	**25.51**		**3.11**		**1.28**		**55.13**	

T_0 and T_1= The treatments without and with micronutrients, respectively .

These results are in agreement with those obtained by **Mohamed (1989)** on chamomile plant; **Jacoub (1995)** on *Ocimum basilicum*; **Mohamed *et al.*, (2001)** on roselle plants; **Abed and Agamy (2002)** on spearmint and **Matter and El-Yazal (2002)** on damsisa; **Farag (2006)** on cotton and tomato plants and **El-Sharkawy *et al*., (2008)** on Jerusalem artichoke plants.

The positive effect of micronutrients on yield and its components were also reported by **Bidwell (1980)** on chrysanthemum, found that spraying the mixture of micro-elements at different doses increased the yield and its components as compared to untreated plants. These increments may be attributed to the positive effect of the micro-elements on most metabolic processes such as carbohydrates, proteins, phosphate RNA and ribosome formation.

3- Chemical constituents :-

3-1- yield of oil:

Data tabulated in Table (4) show that yield of oil i.e. oil percentage, oil yield/plant and per feddan were increased by increasing the NPK fertilizers rates to 100 kg N / fed., 50 kg P and 36 kg/fed. K ($N_2P_2K_2$), respectively in the dry capetulum of chamomile plants. The percentage of increase of oil yield / fed. was reached to, 49.38% as compared to the control plants in the first season, Similar result was observed in the second season.

These results are in agreement with those obtained by **Mohamed (1989)** on chamomile plant; **Jacoub (1995)** on *Ocimum basilicum*; **Farag (2006)** on cotton plants and **Swaefy Hend *et al*. (2007)** on *Mentha piperita* **.**

Table(4): Effect of macro and micronutrients on oil yield of chamomile plant grown under newly reclaimed soil conditions.

Treatments	Oil %		Oil yield /plant(ml)		Oil yield / fed.(L)	
	T_0	T_1	T_0	T_1	T_0	T_1
First season 2004/2005						
Control	0.88	1.00	0.168	0.211	4.70	5.91
$N_2P_1K_1$	0.94	1.10	0.181	0.241	5.07	6.75
$N_1P_2K_1$	0.97	1.12	0.189	0.240	5.29	6.72
$N_1P_1K_2$	0.95	1.11	0.185	0.236	5.18	6.61
$N_2P_2K_1$	0.97	1.10	0.193	0.242	5.40	6.78
$N_2P_1K_2$	0.95	1.08	0.200	0.241	5.60	6.75
$N_1P_2K_2$	1.00	1.15	0.220	0.266	6.16	7.45
$N_2P_2K_2$	1.09	1.19	0.251	0.302	7.00	8.46
Mean	0.96	1.10	0.198	0.247	5.60	6.92
LSD 5%	**0.03**		**0.01**		**0.23**	
Second season 2005 / 2006						
Control	0.90	1.10	0.174	0.232	4.87	6.50
$N_2P_1K_1$	0.95	1.10	0.186	0.240	5.21	6.72
$N_1P_2K_1$	0.98	1.13	0.191	0.246	5.35	6.89
$N_1P_1K_2$	0.95	1.12	0.186	0.242	5.21	6.78
$N_2P_2K_1$	0.97	1.11	0.203	0.245	5.68	6.86
$N_2P_1K_2$	0.97	1.10	0.207	0.252	5.80	7.06
$N_1P_2K_2$	0.99	1.14	0.223	0.263	6.24	7.36
$N_2P_2K_2$	1.05	1.18	0.243	0.299	6.80	8.37
Mean	0.97	1.12	0.202	0.252	5.66	7.06
LSD 5%	**0.03**		**0.02**		**0.31**	

T_0 and T_1= The treatments without and with micronutrients, respectively.

Also, the addition of mixture from micronutrients at the rate of 2% to the NPK fertilizers treatments gave the best results on oil percentage, oil yield/ plant and per feddan as compared to the untreated plants. The maximum increase of oil yield/fed was obtained by the $N_2P_2K_2$ treatment in combination with micronutrients, found to be, 79.90% as compared to the control plants in the first season, the same trend was observed in the second season.

These results are in agreement with those obtained by **Mohamed (1989)** on chamomile plant; **Abed and Agamy (2002)** on spearmint; **Matter and El-Yazal (2002)** on damsisa and **Farag (2006)** on cotton plants.

The superiority of the oil yield by foliar application of micro-elements might be attributed to the role of micro-elements in increasing metabolic processes of carbohydrates, proteins and phosphate and it can directly implicated in nucleic acid metabolism **(Price *et al.* 1972).** Also, it plays a role in regulating the level of auxin oxidase system (**Russell,1989**). Such as results are in according with those obtained by **Gamal El-Din *et al.*(1999)** on lemongrass.

Table (5): Effect of macro and micronutrients on N, P, K, Fe, Mn and Zn concentrations of chamomile leaves grown under newly reclaimed soil conditions.

Treatments	N %		P %		K %		Fe (ppm)		Mn (ppm)		Zn (ppm)	
	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1
First season 2004/2005												
Control	2.45	2.50	0.10	0.12	0.48	0.55	300.0	330.0	192.0	204.0	120.0	129.0
$N_2P_1K_1$	2.53	2.57	0.11	0.14	0.50	0.60	325.0	340.0	206.0	210.0	124.0	137.0
$N_1P_2K_1$	2.50	2.53	0.12	0.14	0.51	0.58	312.0	337.0	207.0	213.0	130.0	134.0
$N_1P_1K_2$	2.46	2.52	0.11	0.13	0.54	0.62	313.0	335.0	208.0	216.0	131.0	136.0
$N_2P_2K_1$	2.58	2.60	0.12	0.16	0.54	0.62	337.0	340.0	216.0	231.0	136.0	140.0
$N_2P_1K_2$	2.58	2.61	0.12	0.14	0.58	0.65	325.0	347.0	216.0	234.0	137.0	149.0
$N_1P_2K_2$	2.55	2.64	0.13	0.15	0.61	0.68	337.0	345.0	219.0	231.0	138.0	148.0
$N_2P_2K_2$	2.60	2.77	0.15	0.20	0.72	0.90	371.0	397.0	233.0	249.0	155.0	167.0
Mean	2.53	2.59	0.12	0.15	0.58	0.65	327.5	346.4	212.1	223.5	133.9	142.5
LSD 5%	**0.05**		**0.02**		**0.03**		**14.0**		**10.0**		**5.0**	
Second season 2005 / 2006												
Control	2.48	2.51	0.11	0.13	0.48	0.55	308.0	331.0	195.0	204.0	120.0	131.0
$N_2P_1K_1$	2.55	2.58	0.12	0.15	0.51	0.61	328.0	342.0	205.0	211.0	125.0	138.0
$N_1P_2K_1$	2.49	2.53	0.11	0.14	0.53	0.59	315.0	340.0	209.0	215.0	132.0	135.0
$N_1P_1K_2$	2.48	2.53	0.11	0.14	0.54	0.63	317.0	338.0	208.0	218.0	131.0	138.0
$N_2P_2K_1$	2.59	2.59	0.13	0.16	0.56	0.61	339.0	345.0	218.0	231.0	138.0	142.0
$N_2P_1K_2$	2.58	2.62	0.14	0.15	0.59	0.66	328.0	349.0	219.0	235.0	137.0	149.0
$N_1P_2K_2$	2.56	2.63	0.13	0.15	0.62	0.68	338.0	350.0	219.0	230.0	137.0	147.0
$N_2P_2K_2$	2.62	2.78	0.16	0.21	0.75	0.91	375.0	410.0	235.0	250.0	159.0	168.0
Mean	2.54	2.60	0.13	0.15	0.57	0.66	331.0	350.6	213.5	224.3	134.9	143.5
LSD 5%	**0.05**		**0.02**		**0.03**		**13.0**		**9.0**		**5.0**	

T_0 and T_1= The treatments without and with micronutrients, respectively.

3-2- N, P, K, Fe, Mn and Zn concentration:

With regard to the concentrations of constituent (N, P, K, Fe, Mn and Zn) of chamomile leaves, data presented in Table (5) clearly showed that fertilizing with high rates N, P and K each alone or together resulted in a significant increase in of N, P, K, Fe, Mn and Zn concentrations as compared to the control plants ($N_1P_1K_1$) at the first season. Generally, the greatest increase was obtained by the treatments $N_2P_2K_2$ (100, 50 and 36 kg/fed.), 6.12; 50.00, 56.52; 23.67;21.35, and 29.17%, respectively, for the above elements. Similar results also, were observed in the second season.

Many researchers found nearly the same results on different plants such as, **Medani (1998)** on damsisa and **Naguib and Aziz (2003)** on *Hyoscyamus muticus* L.; **Farag (2006)** on cotton and tomato plants; **Swaefy Hend *et al.* (2007)** on *Mentha piperita* and **Attoa (2008)** on gladiolus.

It is also clear from the data in Table (5), that foliar application with micronutrients generally increased N, P, K, Fe, Mn and Zn concentrations of leaves as compared to the untreated plants. The markedly increases in these elements concentrations in chamomile leaves were obtained by treatment $N_2P_2K_2$+ micronutrients mixture, which found to be, 13.06for N, 100% for P, 95.63% for K, 32.33% for Fe, 29.69% for Mn and 37.17% for Zn concentrations, in the first season, as compared to the untreated plants ($N_1P_1K_1$**)**. The results in second season were harmony with ones. The present results are in line with those obtained by **Mohamed *et al.*, (2001)** on roselle plants; **Abed and Agamy (2002)** on spearmint **Matter and El-Yazal (2002)** on damsisa; **Farag (2006)** on cotton and tomato plants and **Hassanain *et al.*(2006)** on chamomile plant.

3-3- <u>Pigments and total carbohydrates</u>

Results presented in Table (6), indicated that during the two studied seasons, that treated chamomile plants with the high rates of N (100 kg.), P (50kg/fed. P_2O_5 and K36kg/fed. K_2O) either alone or in combinations caused a positive effect of chlorophyll a, b, carotenoids and total carbohydrates. The maximum increase of these parameters were obtained by the treatment ($N_2P_2K_2$), were 34.33, 50.00, 29.03 and 17.37% for chlorophyll a, b, carotenoids and total carbohydrates, respectively, in the first season, as compared to the control plants.

These results are in agreement with those obtained by **Medani (1998)** on damsisa and **Naguib and Aziz (2003)** on *Hyoscyamus muticus* L.; **Farag (2006)** on cotton and tomato plants; **Swaefy Hend *et al.* (2007)** on *Mentha piperita* and **Attoa (2008)** on gladiolus.

Regarding the effect of mixture of micronutrients application, the data tabulated in Table (6) indicated that the above parameters were significantly increased by spraying plants, especially at present the high rates of N, P and K ($N_2P_2K_2$), where the increase found to be, 47.76, 61.36, 48.39 and 23.25%, respectively, in the first season, as compared to the untreated plants. The same trend was obtained in the second season.

The stimulation effect of micronutrients on pigments, total carbohydrates and oil percentage were also reported by **Mohamed *et al.*, (2001)** on roselle plants; **Abed and Agamy (2002)** on spearmint ; **Hassanain *et al.*(2006)** on chamomile and **Matter and El-Yazal (2002)** on damsisa.

Table(6): Effect of macro and micronutrients on the pigments and total carbohydrates of chamomile plant leaves grown under newly reclaimed soil conditions.

Treatments	Chlorophyll a mg/g F.W		Chlorophyll b mg/g F.W		Carotenoids mg/g F.W		Total carbohydrates mg/g D.W	
	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1
Second season 2004 / 2005								
Control	0.67	0.71	0.44	0.50	0.31	0.34	178.50	181.20
$N_2P_1K_1$	0.71	0.77	0.50	0.54	0.34	0.39	184.60	187.50
$N_1P_2K_1$	0.71	0.76	0.50	0.52	0.34	0.40	188.00	190.50
$N_1P_1K_2$	0.72	0.76	0.52	0.53	0.33	0.38	188.00	188.70
$N_2P_2K_1$	0.80	0.84	0.58	0.60	0.35	0.41	193.20	200.00
$N_2P_1K_2$	0.82	0.87	0.61	0.64	0.37	0.40	197.90	199.10
$N_1P_2K_2$	0.83	0.87	0.61	0.63	0.38	0.40	196.30	198.70
$N_2P_2K_2$	0.90	0.99	0.66	0.71	0.40	0.46	209.50	220.00
Mean	0.77	0.82	0.55	0.58	0.35	0.39	192.00	195.70
LSD 5%	**0.03**		**0.02**		**0.02**		**5.00**	
Second season 2005 / 2006								
Control	0.69	0.72	0.46	0.52	0.30	0.35	180.50	185.50
$N_2P_1K_1$	0.72	0.76	0.51	0.55	0.35	0.40	186.70	188.20
$N_1P_2K_1$	0.71	0.76	0.51	0.53	0.33	0.41	188.90	191.10
$N_1P_1K_2$	0.71	0.78	0.54	0.55	0.34	0.39	188.00	190.00
$N_2P_2K_1$	0.82	0.86	0.59	0.61	0.36	0.40	195.40	199.50
$N_2P_1K_2$	0.84	0.87	0.62	0.64	0.38	0.42	196.20	200.00
$N_1P_2K_2$	0.83	0.88	0.61	0.64	0.38	0.40	196.30	199.80
$N_2P_2K_2$	0.91	1.00	0.68	0.71	0.41	0.45	208.50	221.60
Mean	0.78	0.83	0.56	0.59	0.35	0.40	192.90	196.90
LSD 5%	**0.03**		**0.03**		**0.02**		**6.00**	

T_0 and T_1= The treatments without and with micronutrients, respectively.

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تأثير بعض العناصر الكبرى والصغرى على النمو والمحصول والمكونات الكيماوية لنباتات البابونج النامية تحت ظروف الأراضى المستصلحة حديثا

فيصل محمود عبد المجيد مطر
قسم البساتين- كلية الزراعة – جامعة الفيوم

إجريت هذه الدراسة الحقلية خلال موسمي ٢٠٠٤/٢٠٠٥ و ٢٠٠٥/٢٠٠٦ لبحث تأثير بعض العناصر الكبرى (بالمعدلات ٧٥ – ١٠٠ كجم /ف نيتروجين، ٣٢ – ٥٠ كجم /ف فو٢٥١، ٢٤ – ٣٦ كجم/ف بو ٢أ) وكذلك خليط العناصر الصغرى (الحديد، المنجنيز، الزنك بتركيز ٢%) على النمو والمحصول والمكونات الكيماوية لنبات البابونج. وقد بينت النتائج المتحصل عليها من الدراسة أن معاملة النباتات بالمعدلات العالية من النيتروجين والفوسفور والبوتاسيوم أدت إلى زيادة أو تأثير إيجابي علي كل الصفات التي درست مثل صفات النمو (إرتفاع النبات وعدد الأفرع/نبات، والوزن الطازج والجاف للنبات) وكذا المحصول ومكوناتة (مثل عدد النورات للنبات، والوزن الطازج والجاف للنورات للنبات ووزن محصول النورات الجاف/الفدان) وبعض المكونات الكيماوية (مثل النيتروجين والفوسفور والبوتاسيوم والحديد والزنك والمنجنيز وكلوروفيلات أ و ب والكاروتينيدات والكربوهيدرات الكلية) أيضا محصول الزيت (نسبة الزيت، ومحصول الزيت للنبات والفدان).

وبصفة عامة فأن أقصي زيادة في الصفات السابقة التي درست كانت ناتجة عن المعاملة التي تحتوي علي المعدلات العالية من النيتروجين والفوسفور والبوتاسيوم (١٠٠ و ٥٠ و٣٦ كجم/فدان علي التوالي) مرتبطة بالرش بالعناصر الصغرى (الحديد، المنجنيز، الزنك بتركيز ٢%)٠ وبناء علي ذلك فأنه يفضل تحت ظروف الأراضي المستصلحة حديثا تسميد نباتات البابونج بهذه المعاملة وذلك للحصول علي محصول جيد٠